a more complex garb. BLAAUW's work clearly indicates that the amount of effective light and not the direction of the ray is the determining factor in phototropism. He believes NOAK'S[20] opposing view is due to his overlooking the parabolic curve of the tip in the epicotyl of *Avena*, the shading effect of the sporangia of *Phycomyces* on the perceptive and growth regions of the sporangiophore, and the cylindrical lens effect of the latter organ. On account of its lens action the back of the organ in unilateral light is more strongly illuminated than the front. The matter is rendered more complex by the focal line lying at different depths with variation in the angle of the incident ray.—WILLIAM CROCKER.

The vegetation of Natal.—Perhaps no part of the world is theoretically more interesting and practically less known to the phytogeographer than South Africa, and it is a satisfaction to record the appearance of two excellent papers on the vegetation of Natal by Professor BEWS[21, 22] of the Natal University College. The first paper is of general nature, presenting the ecological factors and plant associations of the province as a whole. Although Natal is situated considerably to the south of the Tropic of Capricorn, much of the area is frostless and has a distinctly tropical vegetation. Especially is this true of the coast, where are to be found such tropical types as the mangroves and Pescaprae. Almost all of the coast line is fringed by dunes, reaching a height of 50–200 feet, and covered chiefly by xerophytic bush. The vegetation of the interior is mostly evergreen dicotylous forest and grassland. The forest (generally called bush) resembles SCHIMPER'S sclerophyll forests, except that they are in regions of summer rather than winter rain. Perhaps the most interesting type of bush is the yellow-wood bush, in which *Podocarpus* dominates. In the Natal bush epiphytes are relatively scarce, but lianas are very abundant. Transitional to the grassland or veld is the thorn veld, essentially a savanna, with a dominance of umbrella-shaped *Acacia* trees. In the veld the grasses are changing, largely because of human influences, and it is noteworthy that the invading grasses are less useful to man than the original grasses. A brief account is given of the marsh or vlei and of secondary associations, that is, those due to human influence.

The second paper is the initial one of a series contemplated by BEWS, dealing in detail with the vegetation of small areas in the province of Natal. In the veld the dominating natural grass is *Anthistiria imberbis;* increasing areas are being given over to the cultivation of wattle (*Acacia mollissima*)

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[20] BOT. GAZ. **58**:88–89. 1914.

[21] BEWS, J. W., The vegetation of Natal. Annals of the Natal Museum **2**[3]:253–331. *pls. 10.* 1912.

[22] ———, An ecological survey of the midlands of Natal, with special reference to the Pietermaritzburg district. Annals of the Natal Museum **2**[4]:485–545. *pls. 7. map 1.* 1913.

and maize (known locally as mealie), and vast areas have been extensively modified by grazing and burning. In the modified veld *Aristida junciformis* largely replaces *Anthistiria*. The bush, vlei, and other types of associations are much less extensive about Pietermaritzburg than are those of the veld. The paper is accompanied by a map, indicating the areas occupied by the different associations.—H. C. COWLES.

The origin of coal.—A recent bulletin[23] from the Bureau of Mines presents the results of extensive researches as to the origin of coal, long a vexed question. WHITE discusses the geologic relations of coals, analyses of coal samples studied under the microscope, physiographic conditions attending the formation of coal, rate of deposition of coal, and regional metamorphism of coal. DAVIS contributes an account of the origin and formation of peat; while THIESSEN describes in detail the results of a microscopic study of coal, prefacing his account with a full historical review of the subject. The bulletin is so full of important facts and interesting inferences that it is impossible to recount them here, but some of the general conclusions may be mentioned.

An important conclusion is that all coal was laid down in beds analogous to the peat beds of today; and that all kinds of plants, in whole or in part, went into the deposit. The various materials entering into the structure of plants differ widely in their resistance to the various agencies that were concerned in peat formation and in the subsequent coal formation. At the death of the plants, dependent upon the conditions in the bog, a partial decomposition, maceration, elimination, and chemical reduction begins, brought about chiefly by organic agencies, mainly fungi at first, and later bacteria. Such labile substances as proteins are removed first, and the more resistant next, leaving the most resistant in the residue called peat. The various processes referred to above, conducted chiefly by biochemical agencies, are taken up and continued by "dynamochemical" agencies, through various later stages, resulting in the different grades of coal, as lignite, subbituminous, bituminous, cannel coal, and anthracite. "Coal, therefore, is chiefly composed of residue consisting of the most resistant components, of which resins, resin waxes, waxes, and higher fats, or the derivatives of the compounds composing these, are the most important." These substances perform mainly protective functions in plants, as in cuticles, spore exines (including pollen), bark, cork, and waxy coverings. A very interesting result of these investigations is that any algal origin of coal was not demonstrated, although this has been a conspicuous and perhaps favorite theory.—J. M. C.

Water requirement of plants.—The ratio of the amount of water taken up by a plant during its growth to the dry matter produced has been found to vary very much, and it would seem that its careful investigation would

[23] WHITE, DAVID, and THIESSEN, REINHARDT, The origin of coal. Bull. 38, Dept. Interior, Bureau of Mines. pp. x+390. *pls.* 54. 1913.